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PTO/SB/21 (08-00)

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Application 09/835,483

Filing Date April 16, 2001

First Named Majid Anwar

Group Art Unit 2673

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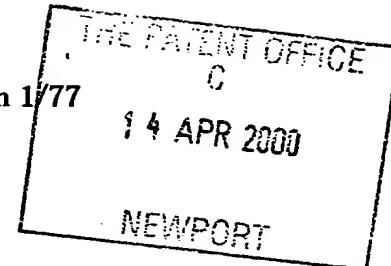
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Picsel Technologies Limited
Shaftesbury House
5 Waterloo Street
GLASGOW
G2 6AY

Patents ADP number (*if you know it*)

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4. Title of the invention

"Digital Document Processing"

5. Name of your agent (*if you have one*)

Murgitroyd & Company

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1 **"Digital Document Processing"**

2

3 **Field of the Invention**

4

5 The invention relates to data processing systems. More
6 particularly, the invention relates to methods and
7 systems for processing "digital documents" (as defined
8 herein) and to devices incorporating such methods and
9 systems. In general terms, the invention is concerned
10 with generating an output representation of a source
11 document; e.g. as a visual display or as hardcopy.

12

13 **Background to the Invention**

14

15 As used herein, the term "digital document" is used to
16 describe a digital representation of any type of data
17 processed by a data processing system which is
18 intended, ultimately, to be output in some form, in
19 whole or in part, to a human user, typically by being
20 displayed or reproduced visually (e.g. by means of a
21 visual display unit or printer), or by text-to-speech
22 conversion, etc. A digital document may include any

1 features capable of representation, including but not
2 limited to the following: text; graphical images;
3 animated graphical images; full motion video images;
4 interactive icons, buttons, menus or hyperlinks. A
5 digital document may also include non-visual elements
6 such as audio (sound) elements.

7

8 Data processing systems, such as personal computer
9 systems, are typically required to process "digital
10 documents", which may originate from any one of a
11 number of local or remote sources and which may exist
12 in any one of a wide variety of data formats ("file
13 formats"). In order to generate an output version of
14 the document, whether as a visual display or printed
15 copy, for example, it is necessary for the computer
16 system to interpret the original data file and to
17 generate an output compatible with the relevant output
18 device (e.g. monitor, or other visual display device,
19 or printer). In general, this process will involve an
20 application program adapted to interpret the data file,
21 the operating system of the computer, a software
22 "driver" specific to the desired output device and, in
23 some cases (particularly for monitors or other visual
24 display units), additional hardware in the form of an
25 expansion card.

26

27 This conventional approach to the processing of digital
28 documents in order to generate an output is inefficient
29 in terms of hardware resources, software overheads and
30 processing time, and is completely unsuitable for low
31 power, portable data processing systems, including
32 wireless telecommunication systems, or for low cost

1 data processing systems such as network terminals, etc.
2 Other problems are encountered in conventional digital
3 document processing systems, including the need to
4 configure multiple system components (including both
5 hardware and software components) to interact in the
6 desired manner, and inconsistencies in the processing
7 of identical source material by different systems (e.g.
8 differences in formatting, colour reproduction, etc.).
9 In addition, the conventional approach to digital
10 document processing is unable to exploit the
11 commonality and/or re-usability of file format
12 components.

13

14 **Summary of the Invention**

15

16 It is an object of the present invention to provide
17 digital document processing methods and systems, and
18 devices incorporating such methods and systems, which
19 obviate or mitigate the aforesaid disadvantages of
20 conventional methods and systems.

21

22 The invention, in its various aspects, is defined in
23 the Claims appended hereto. Further aspects and
24 features of the invention will be apparent from the
25 following description.

26

27 In a first aspect, the invention relates to a digital
28 document processing system comprising:

29 means for receiving an input bytestream
30 representing source data in one of a plurality of
31 predetermined data formats;

1 interpreting means for interpreting said
2 bytestream;
3 converting means for converting interpreted
4 content from said bytestream into an internal
5 representation data format;
6 means for processing said internal representation
7 data so as to generate output representation data
8 adapted to drive an output device.
9
10 In a second aspect, the invention relates to a
11 graphical user interface for a data processing system
12 in which interactive visual displays employed by the
13 user interface are generated by means of a digital
14 document processing system in accordance with the first
15 aspect of the invention and to data processing systems
16 incorporating such a graphical user interface.
17
18 In further aspects, the invention relates to various
19 types of device incorporating a digital document
20 processing system in accordance with the first aspect
21 of the invention, including hardware devices, data
22 processing systems and peripheral devices.
23
24 In still another aspect, the invention relates to a
25 graphical user interface for a data processing system,
26 having one or more of a number of novel and/or enhanced
27 features, and to data processing systems incorporating
28 such a graphical user interface.
29
30 Embodiments of the invention will now be described, by
31 way of example only, with reference to the accompanying
32 drawing.

1

2

3 **Brief Description of the Drawing**

4

5 Fig. 1 is a block diagram illustrating an embodiment of
6 a digital document processing system in accordance with
7 the present invention.

8

9 **Detailed Description of the Preferred Embodiments**

10

11 Referring now to the drawings, a digital document
12 processing system 8 embodying the invention is
13 illustrated in Fig. 1.

14

15 In general terms, the system 8 will process a source
16 document 10 comprising a data file in a known format.
17 The input to the system 8 is a bytestream comprising
18 the content of the source document. An input module 11
19 identifies the file format of the source document on
20 the basis of any one of a variety of criteria, such as
21 an explicit file-type identification within the
22 document, from the file name (particularly the file
23 name extension), or from known characteristics of the
24 content of particular file types. The bytestream is
25 input to a "document agent" 12, specific to the file
26 format of the source document. The document agent 12 is
27 adapted to interpret the incoming bytestream and to
28 convert it into a standard format employed by the
29 system 8, resulting in an internal representation 14 of
30 the source data in a "native" format suitable for
31 processing by the system 8. The system 8 will
32 generally include a plurality of different document

1 agents 12, each adapted to process one of a
2 corresponding plurality of predetermined file formats.
3

4 The system 8 may also be applied to input received from
5 an input device such as a digital camera or scanner.
6 In this case the input bytestream may originate
7 directly from the input device, rather from a "source
8 document" as such. However, the input bytestream will
9 still be in a predictable data format suitable for
10 processing by the system and, for the purposes of the
11 invention, input received from such an input device may
12 be regarded as a "source document".
13

14 The document agent 12 employs a library 16 of standard
15 objects to generate the internal representation 14,
16 which describes the content of the source document in
17 terms of a collection of generic objects as defined in
18 the library 16, together with parameters defining the
19 properties of specific instances of the various generic
20 objects within the document. It will be understood
21 that the internal representation may be saved/stored in
22 a file format native to the system and that the range
23 of possible source documents 10 input to the system 8
24 may include documents in the system's native file
25 format. It is also possible for the internal
26 representation 14 to be converted into any of a range
27 of other file formats if required, using suitable
28 conversion agents (not shown).
29

30 The generic objects employed in the internal
31 representation 14 will typically include: text, bitmap
32 graphics and vector graphics (which may or may not be

1 animated and which may be two- or three-dimensional),
2 video, audio, and a variety of types of interactive
3 object such as buttons and icons. The parameters
4 defining specific instances of generic objects will
5 generally include dimensional co-ordinates defining the
6 physical shape, size and location of the object and any
7 relevant temporal data for defining objects whose
8 properties vary with time (allowing the system to deal
9 with dynamic document structures and/or display
10 functions). For text objects, the parameters will
11 normally also include a font and size to be applied to
12 a character string. Object parameters may also define
13 other properties, such as transparency.

14

15 The format of the internal representation 14 separates
16 the "structure" (or "layout") of the documents, as
17 described by the object types and their parameters,
18 from the "content" of the various objects; e.g. the
19 character string (content) of a text object is
20 separated from the font, character size and dimensional
21 parameters of the object; the image data (content) of a
22 graphic object is separated from its dimensional
23 parameters. This allows document structures to be
24 defined in a very compact manner and provides the
25 option for content data to be stored remotely and to be
26 fetched by the system only when needed.

27

28 The internal representation 14 describes the document
29 and its constituent objects in terms of "high-level"
30 descriptions.

31

1 The internal representation data 14 is input to a
2 parsing and rendering module 18 which generates a
3 context-specific representation 20 or "view" of the
4 document represented by the internal representation 14.
5 The required view may be of the whole document or of
6 part(s) (subset(s)) thereof. The parser/renderer 18
7 receives view control inputs 40 which define the
8 viewing context and any related temporal parameters of
9 the specific document view which is to be generated.
10 For example, the system may be required to generate a
11 zoomed view of part of a document, and then to pan or
12 scroll the zoomed view to display adjacent portions of
13 the document. The view control inputs 40 are
14 interpreted by the parser/renderer 18 in order to
15 determine which parts of the internal representation
16 are required for a particular view and how, when and
17 for how long the view is to be displayed.
18
19 The context-specific representation/view 20 is again
20 expressed in terms of object types and parameters,
21 using the library 16.
22
23 The parser/renderer 18 may also perform additional pre-
24 processing functions on the relevant parts of the
25 internal representation 14 when generating the required
26 view 20 of the source document 10. The view
27 representation 20 is input to a shape processor module
28 22 for final processing to generate a final output 24,
29 in a format suitable for driving an output device 26
30 (or multiple output devices), such as a display device
31 or printer.
32

1 The pre-processing functions of the parser/renderer 18
2 may include colour correction, resolution
3 adjustment/enhancement and anti-aliasing. Resolution
4 enhancement may comprise scaling functions which
5 preserve the legibility of the content of objects when
6 displayed or reproduced by the target output device.
7 Resolution adjustment may be context-sensitive; e.g.
8 the display resolution of particular objects may be
9 reduced while the displayed document view is being
10 panned or scrolled and increased when the document view
11 is static.

12

13 There may be a feedback path 42 between the
14 renderer/parser 18 and the internal representation 14;
15 e.g. for the purpose of triggering an update of the
16 content of the internal representation 14, such as in
17 the case where the document 10 represented by the
18 internal representation comprises a multi-frame
19 animation.

20

21 The output representation 20 from the parser/renderer
22 18 expresses the document in terms of "primitive"
23 objects. For each document object, the representation
24 20 preferably defines the object at least in terms of a
25 physical, rectangular boundary box, the actual shape of
26 the object bounded by the boundary box, the data
27 content of the object, and its transparency.

28

29 The shape processor 22 interprets the representation 20
30 and converts it into an output frame format 24
31 appropriate to the target output device 26; e.g. a dot-
32 map for a printer, vector instruction set for a

1 plotter, or bitmap for a display device. An output
2 control input 44 to the shape processor 22 defines the
3 necessary parameters for the shape processor 22 to
4 generate output 24 suitable for a particular output
5 device 26.

6

7 The shape processor 22 preferably processes the objects
8 defined by the view representation 20 in terms of
9 "shape" (i.e. the outline shape of the object), "fill"
10 (the data content of the object) and "alpha" (the
11 transparency of the object), performs scaling and
12 clipping appropriate to the required view and output
13 device, and expresses the object in terms appropriate
14 to the output device (typically in terms of pixels by
15 scan conversion or the like, for most types of display
16 device or printer).

17

18 The shape processor 22 preferably includes an edge
19 buffer which defines the shape of an object in terms of
20 scan-converted pixels, and preferably applies anti-
21 aliasing to the outline shape. Anti-aliasing is
22 preferably performed in a manner determined by the
23 characteristics of the output device 26 (i.e. on the
24 basis of the control input 44), by applying a grey-
25 scale ramp across the object boundary. This approach
26 enables memory efficient shape-clipping and shape-
27 intersection processes.

28

29 A look-up table may be employed to define multiple tone
30 response curves, allowing non-linear rendering control
31 (gamma correction).

32

1 The individual objects processed by the shape processor
2 are combined in the composite output frame 24. The
3 quality of the final output can also be controlled by
4 the user via the output control input 44.

5

6 The shape processor 22 has a multi-stage pipeline
7 architecture which lends itself to parallel processing
8 of multiple objects, or of multiple documents, or of
9 multiple subsets of one or more document, by using
10 multiple instances of the shape processor pipeline.
11 The pipeline architecture is also easily modified to
12 include additional processing functions (e.g. filter
13 functions) if required. Outputs from multiple shape
14 processors 22 may generate multiple output frames 24 or
15 may be combined in a single output frame 24.

16

17 The system architecture is modular in nature. This
18 enables, for example, further document agents to be
19 added as and when required, to deal with additional
20 source file formats. The modular architecture also
21 allows individual modules such as the library 16,
22 parser/renderer 18 or shape processor 22 to be modified
23 or upgraded without requiring changes to other modules.

24

25 The system architecture as a whole also lends itself to
26 parallelism in whole or in part for simultaneous
27 processing of multiple input documents 10a, 10b etc. or
28 subsets of documents, in one or more file formats, via
29 one or more document agents 12, 12a. The integrated,
30 modular nature of the system allows multiple instances
31 of system modules to be spawned within a data
32 processing system or device as and when required,

1 limited only by available processing and memory
2 resources.

3

4 The potential for flexible parallelism provided by the
5 system as a whole and the shape processor 22 in
6 particular allows the display path for a given device
7 to be optimised for available bandwidth and memory.
8 Display updates and animations may be improved, being
9 quicker and requiring less memory. The
10 object/parameter document model employed is
11 deterministic and consistent. The system is fully
12 scalable and allows multiple instances of the system
13 across multiple CPUs.

14

15 The parser/renderer 18 and shape processor 22 interact
16 dynamically in response to view control inputs 40, in a
17 manner which optimises the use of available memory and
18 bandwidth. This applies particularly to re-draw
19 functions when driving a visual display, e.g. when the
20 display is being scrolled or panned by a user.

21

22 Firstly, the system preferably implements a scalable
23 deferred re-draw model, such that the display
24 resolution of a document view, or of one or more
25 objects within a view, varies dynamically according to
26 the manner in which the display is to be modified. As
27 previously mentioned, this might typically involve an
28 object being displayed at reduced resolution whilst
29 being moved on-screen and being displayed at full
30 resolution when at rest. The system may employ
31 multiple levels of display quality for this purpose.
32 Typically, this will involve pre-built, low resolution

1 bitmap representations of document objects and/or
2 dynamically built and scaled bitmaps, with or without
3 interpolation. This approach provides a highly
4 responsive display which makes best use of available
5 memory/bandwidth.

6

7 The interaction of the renderer/parser 18 and shape
8 processor 22 preferably also involves dividing the page
9 to be viewed into zones. Each zone has associated with
10 it a list of all objects contained within or
11 overlapping that zone. Re-draws can then be processed
12 on the basis of the zones, so that the system need only
13 process objects associated with the relevant zones
14 affected by the re-draw. This approach facilitates
15 parallel processing and improves efficiency and reduces
16 redundancy. The use of zones also facilitates the use
17 of the system to generate different outputs for
18 different display devices (e.g. for generating a
19 composite/mosaic output for display by an array of
20 separate display screens).

21

22 The ability to process transparent objects is a
23 significant feature of the system. However, this
24 necessitates the use of off-screen buffering in the
25 shape processor 22 in order to assemble a final output
26 frame. Typically, an off-screen buffer will cover an
27 area larger than the immediate display area, allowing a
28 limited degree of panning/scrolling within the buffer
29 area, but the entire buffer has to be re-centred and
30 re-built when the required display moves outwith these
31 limits. Preferably, the system improves the efficiency
32 of such buffering processes by defining the buffer

1 content as an array of tiles, indexed in an ordered
2 list. When the required display view moves outwith the
3 buffer area, it is then only necessary to discard those
4 tiles which are no longer required, build new tiles to
5 cover the new area of the display and update the tile
6 list. This is faster and more efficient than
7 conventional buffering processes and facilitates the
8 use of multiple buffering and off-screen caching. It
9 also facilitates interruptable re-draw functions (e.g.
10 so that a current re-draw may be interrupted and a new
11 re-draw initiated in response to user input).

12

13 The zoning and tiling schemes described above are
14 independent in principle but may be combined
15 advantageously; i.e. zones may correlate with one or
16 more tiles. Again this facilitates parallelism and
17 optimises use of system resources.

18

19 The system preferably employs a device-independent
20 colour model, suitably a luminance/chrominance model
21 such as the CIE L*a*b* 1976 model. This reduces
22 redundancy in graphic objects, improves data
23 compressibility and improves consistency of colour
24 output between different output devices. Device-
25 dependent colour correction can be applied on the basis
26 of the device-dependent control input 44 to the shape
27 processor 22.

28

29 Fig. 1 shows the system having an input end at which
30 the source bytestream is received and an output end
31 where the final output frame 24 is output from the
32 system. However, it will be understood that the system

1 may include intermediate inputs and outputs at other
2 intermediate stages, such as for fetching data content
3 or for saving/convert ing data generated in the course
4 of the process.

5

6 The system 8 may be incorporated into a variety of
7 types of data processing systems and devices, and into
8 peripheral devices, in a number of different ways.

9 In a general purpose data processing system (the "host
10 system"), the system of the present invention may be
11 incorporated alongside the operating system and
12 applications of the host system or may be incorporated
13 fully or partially into the host operating system.

14

15 For example, the system of the present invention
16 enables rapid display of a variety of types of data
17 files on portable data processing devices with LCD
18 displays without requiring the use of browsers or
19 application programs. This class of data processing
20 devices requires small size, low power processors for
21 portability. Typically, this requires the use of
22 advanced RISC-type core processors designed into ASICs
23 (application specific integrated circuits), in order
24 that the electronics package is as small and highly
25 integrated as possible. This type of device also has
26 limited random access memory and typically has no non-
27 volatile data store (e.g. hard disk). Conventional
28 operating system models, such as are employed in
29 standard desktop computing systems (PCs), require high
30 powered central processors and large amounts of memory
31 in order to process digital documents and generate
32 useful output, and are entirely unsuited for this type

1 of data processing device. In particular, conventional
2 systems do not provide for the processing of multiple
3 file formats in an integrated manner. By contrast, the
4 present invention utilises common processes and
5 pipelines for all file formats, thereby providing a
6 highly integrated document processing system which is
7 extremely efficient in terms of power consumption and
8 usage of system resources.

9

10 The system of the present invention may be integrated
11 at the BIOS level of portable data processing devices
12 to enable document processing and output with much
13 lower overheads than conventional system models.

14 Alternatively, the invention may be implemented at the
15 lowest system level just above the transport protocol
16 stack. For example, the system may be incorporated
17 into a network device (card) or system, to provide in-
18 line processing of network traffic (e.g. working at the
19 packet level in a TCP/IP system).

20

21 In a particular device, the system of the invention is
22 configured to operate with a predetermined set of data
23 file formats and particular output devices; e.g. the
24 visual display unit of the device and/or at least one
25 type of printer.

26

27 Examples of portable data processing devices which may
28 employ the present system include "palmtop" computers,
29 portable digital assistants (PDAs, including tablet-
30 type PDAs in which the primary user interface comprises
31 a graphical display with which the user interacts
32 directly by means of a stylus device), internet-enabled

1 mobile telephones and other communications devices,
2 etc.

3

4 The system may also be incorporated into low cost data
5 processing terminals such as enhanced telephones and
6 "thin" network client terminals (e.g. network terminals
7 with limited local processing and storage resources),
8 and "set-top boxes" for use in interactive/internet-
9 enabled cable TV systems.

10

11 When integrated with the operating system of a data
12 processing system, the system of the present invention
13 may also form the basis of a novel graphical user
14 interface (GUI) for the operating system (OS).

15 Documents processed and displayed by the system may
16 include interactive features such as menus, buttons,
17 icons etc. which provide the user interface to the
18 underlying functions of the operating system. By
19 extension, a complete OS/GUI may be expressed,
20 processed and displayed in terms of system "documents".
21 The OS/GUI could comprise a single document with
22 multiple "chapters".

23

24 The system enables and/or facilitates a variety of
25 novel and/or enhanced GUI features, including, but not
26 limited to, the following:

27

28 - The use of thumbnail images of documents for
29 navigation purposes and for recording user activities
30 (history); e.g. when browsing network content.

1 - Document interaction functions and gesture-based
2 commands using pointing devices and/or touch-screen
3 technology; e.g.:
4 allowing document interaction by means of gestures
5 analogous to actions used with physical documents
6 or books, such as dragging a pointer across a page
7 in order to turn the page ("page-flipping"),
8 dragging a pointer to curl back the corner of a
9 page to view underlying parts of succeeding pages
10 ("page curl");
11 allowing tool selection by dragging tools from
12 toolbars and de-selection by dragging tools to
13 predetermined parts of the display;
14 symbolic cursor movements to indicate particular
15 OS commands, such as "tick", "cross-out" and
16 "circle" movements for "OK", "delete" and
17 "select"; editing commands based on conventional
18 "proof-readers" notation;
19 - Re-formatting document views by rotation or
20 switching between landscape and portrait formats;
21 - Utilities and tools such as:
22 a floating virtual "magnifying glass" which
23 magnifies the underlying document area, in which
24 the magnified view is based on the internal
25 representation 14 of the source document rather
26 than on a bitmap representation of the document
27 and which may modify document parameters such as
28 background and/or foreground colours;
29 a floating virtual, translucent keyboard for text
30 input using a pointing device/touch screen;

1 a floating, virtual, translucent ruler which is
2 re-scalable using any of a variety of user-
3 selectable units.
4 - Alternative menu or "tabbed page" drag out/pull
5 down functions.
6 - Simulation of physical inertia/momentum applied to
7 page scrolling/panning functions (e.g. when a zoomed
8 display of a page is dragged to scroll the display and
9 released, the moving display decelerates gradually
10 after release).
11
12 GUI features of this type provide new or enhanced
13 functionality and/or improve the subjective quality of
14 the user interface.
15
16 The system of the present invention may also be
17 incorporated into peripheral devices such as hardcopy
18 devices (printers and plotters), display devices (such
19 as digital projectors), networking devices, input
20 devices (cameras, scanners etc.) and also multi-
21 function peripherals (MFPs).
22
23 When incorporated into a printer, the system enables
24 the printer to receive raw data files from the host
25 data processing system and to reproduce the content of
26 the original data file correctly, without the need for
27 particular applications or drivers provided by the host
28 system. This avoids the need to configure a computer
29 system to drive a particular type of printer. The
30 present system directly generates a dot-mapped image of
31 the source document suitable for output by the printer
32 (this is true whether the system is incorporated into

1 the printer itself or into the host system). Similar
2 considerations apply to other hardcopy devices such as
3 plotters.

4

5 When incorporated into a display device, such as a
6 projector, the system again enables the device to
7 display the content of the original data file correctly
8 without the use of applications or drivers on the host
9 system, and without the need for specific configuration
10 of the host system and/or display device. Peripheral
11 devices of these types, when equipped with the present
12 system, may receive and output data files from any
13 source, via any type of data communications network.

14

15 From the foregoing, it will be understood that the
16 system of the present invention may be "hard-wired;
17 e.g. implemented in ROM and/or integrated into ASICs or
18 other single-chip systems, or may be implemented as
19 firmware (programmable ROM such as flashable ePROM), or
20 as software, being stored locally or remotely and being
21 fetched and executed as required by a particular
22 device.

23

24 Improvements and modifications may be incorporated
25 without departing from the scope of the present
26 invention.

27

1 Claims

2

3 1. A digital document processing system comprising:

4 means for receiving an input bytestream

5 representing source data in one of a plurality of

6 predetermined data formats;

7 interpreting means for interpreting said

8 bytestream;

9 converting means for converting interpreted

10 content from said bytestream into an internal

11 representation data format;

12 . means for processing said internal representation

13 data so as to generate output representation data

14 adapted to drive an output device.

15

16 2. A system as claimed in Claim 1, wherein said

17 source data defines the content and structure of a

18 digital document, and wherein said internal

19 representation data describes said structure in terms

20 of generic objects defining a plurality of data types

21 and parameters defining properties of specific

22 instances of generic objects, separately from said

23 content.

24

25 3. A system as claimed in Claim 2, further including

26 a library of generic objects, said internal

27 representation data being based on the content of said

28 library.

29

30 4. A system as claimed in Claim 2 or Claim 3,

31 including a parsing and rendering module adapted to

32 generate an object and parameter based representation

1 of a specific view of at least part of said internal
2 representation data, on the basis of a first control
3 input to said parsing and rendering module.

4

5 5. A system as defined in Claim 4, further including
6 a shape processing module adapted to receive said
7 object and parameter based representation of said
8 specific view from said parsing and rendering module
9 and to convert said object and parameter based
10 representation into an output data format suitable for
11 driving a particular output device.

12

13 6. A system as claimed in Claim 5, wherein said shape
14 processing module processes said objects on the basis
15 of a boundary box defining the boundary of an object, a
16 shape defining the actual shape of the object bounded
17 by the boundary box, the data content of the object and
18 the transparency of the object.

19

20 7. A system as claimed in Claim 6, wherein said shape
21 processor is adapted to apply grey-scale anti-aliasing
22 to the edges of said objects.

23

24 8. A system as claimed in Claim 5, Claim 6 or Claim
25 7, wherein said shape processing module has a pipeline
26 architecture.

27

28 9. A system as claimed in any one of Claims 5 to 8,
29 wherein said shape processor employs at least one off-
30 screen display buffer to generate said output data and
31 wherein said at least one off-screen display buffer is
32 defined by an indexed array of tiles.

1 10. A system as defined in Claim 9, wherein updating
2 of the content of said at least one off-screen display
3 buffer is performed by removing selected tiles from
4 said array, adding new tiles to said array, and up-
5 dating the indexing of said tiles.

6

7 11. A system as claimed in any one of Claims 5 to 10,
8 wherein said parsing and rendering module is adapted to
9 define at least part of said internal representation
10 data it terms of a plurality of zones, each zone having
11 an associated list of objects contained within and
12 overlapping said zone, and said shape processor is
13 adapted to process said object and parameter based
14 representation on the basis of said zones and
15 associated lists.

16

17 12. A system as claimed in any one of Claims 5 to 11,
18 wherein the quality of a display view represented by
19 said output data may be varied dependent on said first
20 control input.

21

22 13. A system as claimed in Claim 12, wherein the
23 quality of said display view may be varied in multiple
24 steps.

25

26 14. A system as claimed in any one of Claims 2 to 13,
27 wherein said object parameters include dimensional,
28 physical and temporal parameters.

29

30 15. A system as claimed in any preceding Claim,
31 wherein the system employs a chrominance/luminance-
32 based colour model to describe colour data.

- 1
- 2 16. A system as claimed in any preceding Claim,
3 wherein the system is adapted for multiple parallel
4 implementation in whole or in part for processing one
5 or more sets of source data from one or more data
6 sources and for generating one or more sets of output
7 representation data.
- 8
- 9 17. A graphical user interface for a data processing
10 system in which interactive visual displays employed by
11 the user interface are generated by means of a digital
12 document processing system as claimed in any one of
13 Claims 1 to 16.
- 14
- 15 18. A data processing device incorporating a graphical
16 user interface as claimed in Claim 17.
- 17
- 18 19. A hardware device for data processing and/or
19 storage encoding a digital document processing system
20 as claimed in any one of Claims 1 to 16.
- 21
- 22 20. A hardware device as claimed in Claim 19, further
23 including a core processor system.
- 24
- 25 21. A hardware device as claimed in Claim 20, wherein
26 said core processor is a RISC processor.
- 27
- 28 22. A data processing system including a digital
29 document processing system as claimed in any one of
30 Claims 1 to 16.
- 31

1 23. A data processing system as claimed in Claim 22,
2 wherein said data processing system comprises a
3 portable data processing device.

4

5 24. A data processing system as claimed in Claim 23,
6 wherein said portable data processing device comprises
7 a wireless telecommunications device.

8

9 25. A data processing system as claimed in Claim 22,
10 wherein said data processing system comprises a network
11 user-terminal.

12

13 26. A peripheral device for use with a data processing
14 system, including a digital document processing system
15 as claimed in any one of Claims 1 to 16.

16

17 27. A peripheral device as claimed in Claim 26,
18 wherein said peripheral device is a visual display
19 device.

20

21 28. A peripheral device as claimed in Claim 26,
22 wherein said peripheral device is a hardcopy output
23 device.

24

25 29. A peripheral device as claimed in Claim 26,
26 wherein said peripheral device is an input device.

27

28 30. A peripheral device as claimed in Claim 26,
29 wherein said peripheral device is a network device.

30

1 31. A peripheral device as claimed in Claim 26,
2 wherein said peripheral device is a multi-function
3 peripheral device.

4

5 32. A graphical user interface for a data processing
6 system, including at least one of the following
7 features:

- 8 - the use of thumbnail images of documents for
9 navigation purposes and for recording user activities;
- 10 - document interaction functions and gesture-based
11 commands using pointing devices and/or touch-screen
12 technology, including document interaction by means of
13 gestures analogous to actions used with physical
14 documents or books;
- 15 - tool selection by dragging tools from toolbars and
16 de-selection by dragging tools to predetermined parts
17 of the display;
- 18 - symbolic cursor movements to indicate commands;
- 19 - re-formatting document views by rotation or
20 switching between landscape and portrait formats;
- 21 - alternative menu or "tabbed page" drag out/pull
22 down functions.
- 23 - simulated physical inertia/momentum applied to
24 page scrolling/panning functions.

25

26 33. A graphical user interface for a data processing
27 system, including at least one of the following
28 utilities/tools:

- 29 - a floating virtual magnifying glass adapted to
30 magnify an underlying document area, in which the
31 magnified view is based on source document data;

1 - a floating virtual, translucent keyboard for
2 text input using a pointing device/touch screen;
3 - a floating, virtual, translucent ruler which is
4 re-scalable using any of a variety of user-
5 selectable units.

6

7 34. A data processing system incorporating a graphical
8 user interface as claimed in Claim 32 or Claim 33.

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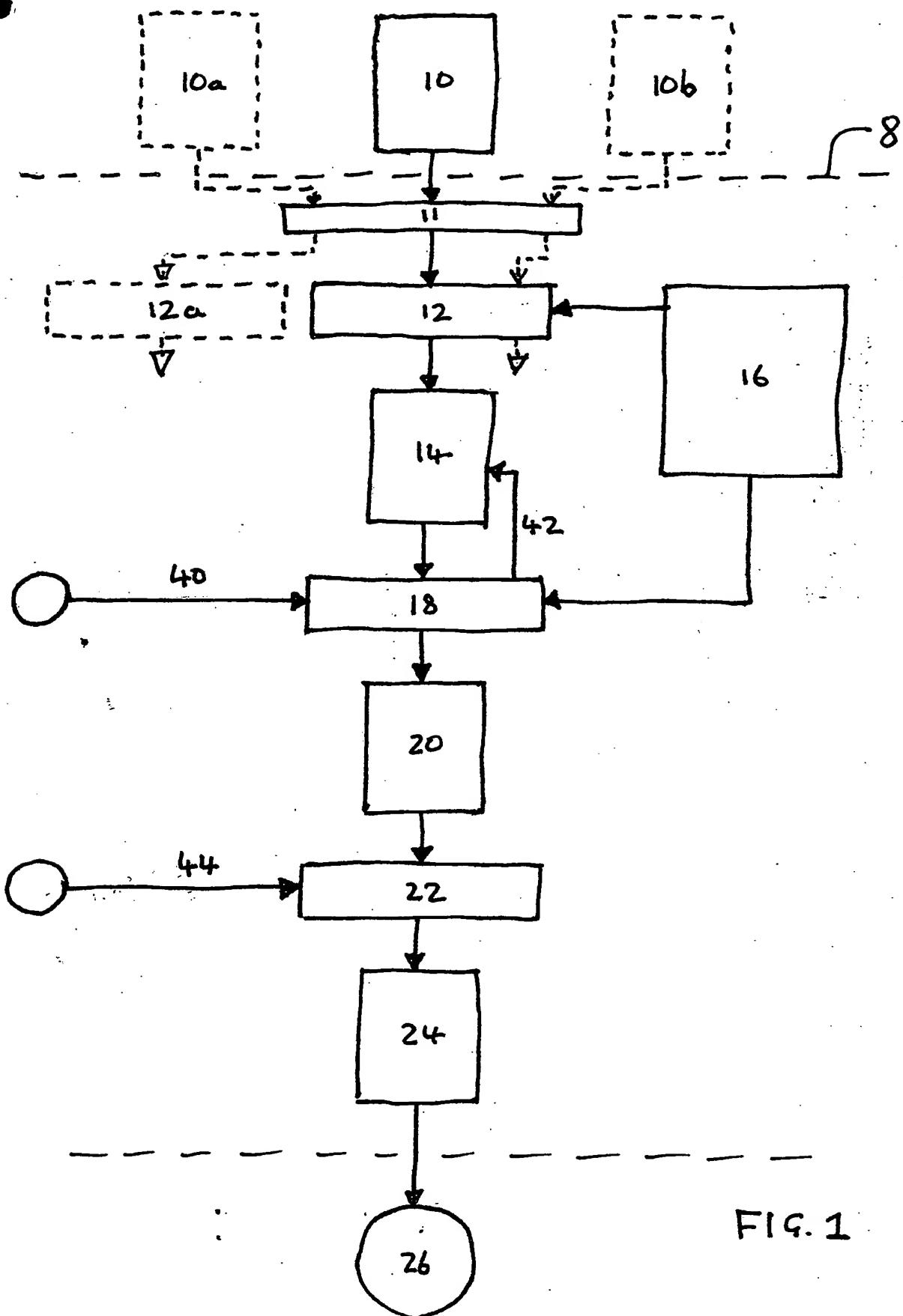


FIG. 1

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